

Abstract

A critical factor that limits the overall performance of an interferometric phase stabilization link in a phase reference distribution system (PRDS) is a phase detector used to monitor phase drifts.

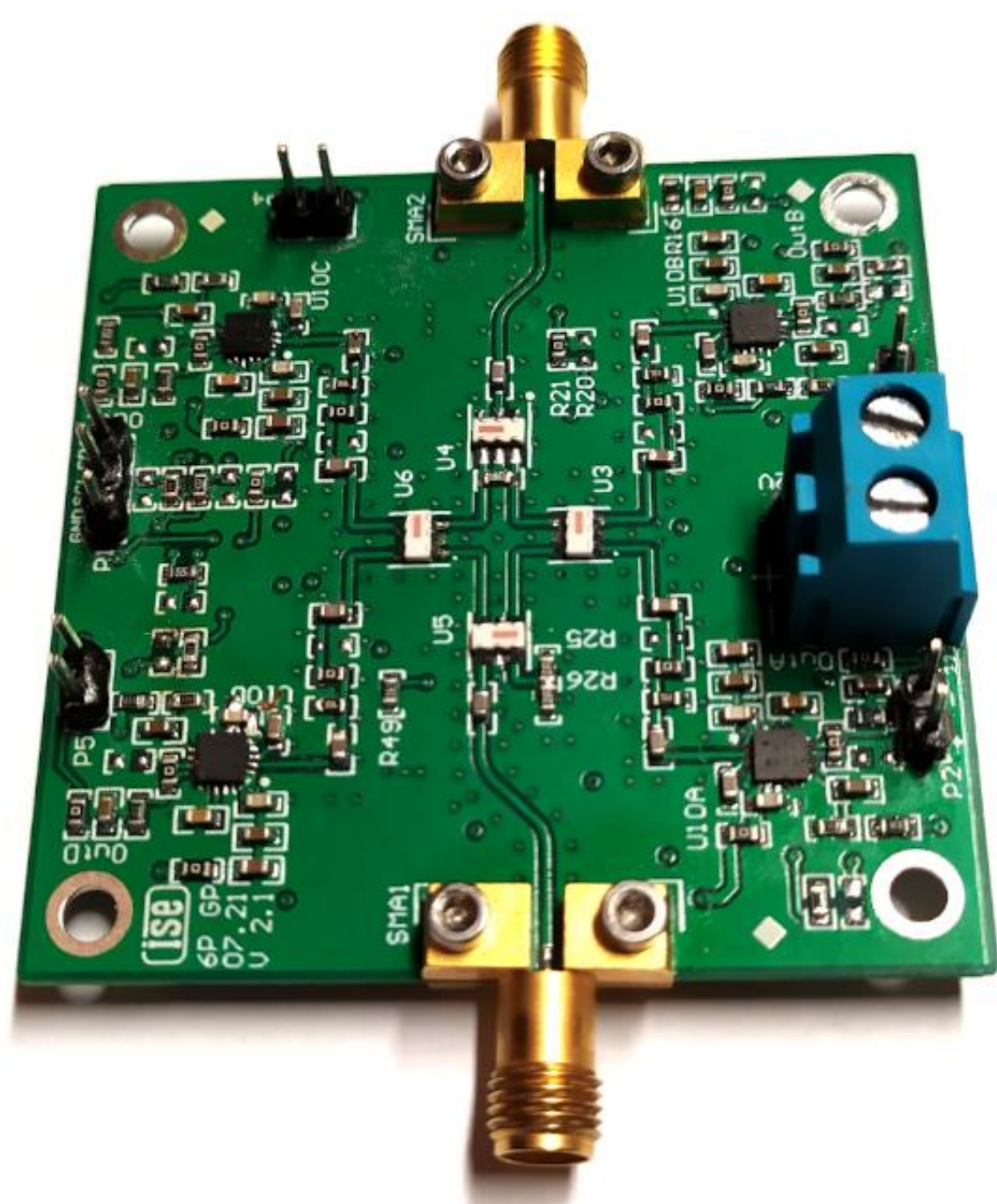
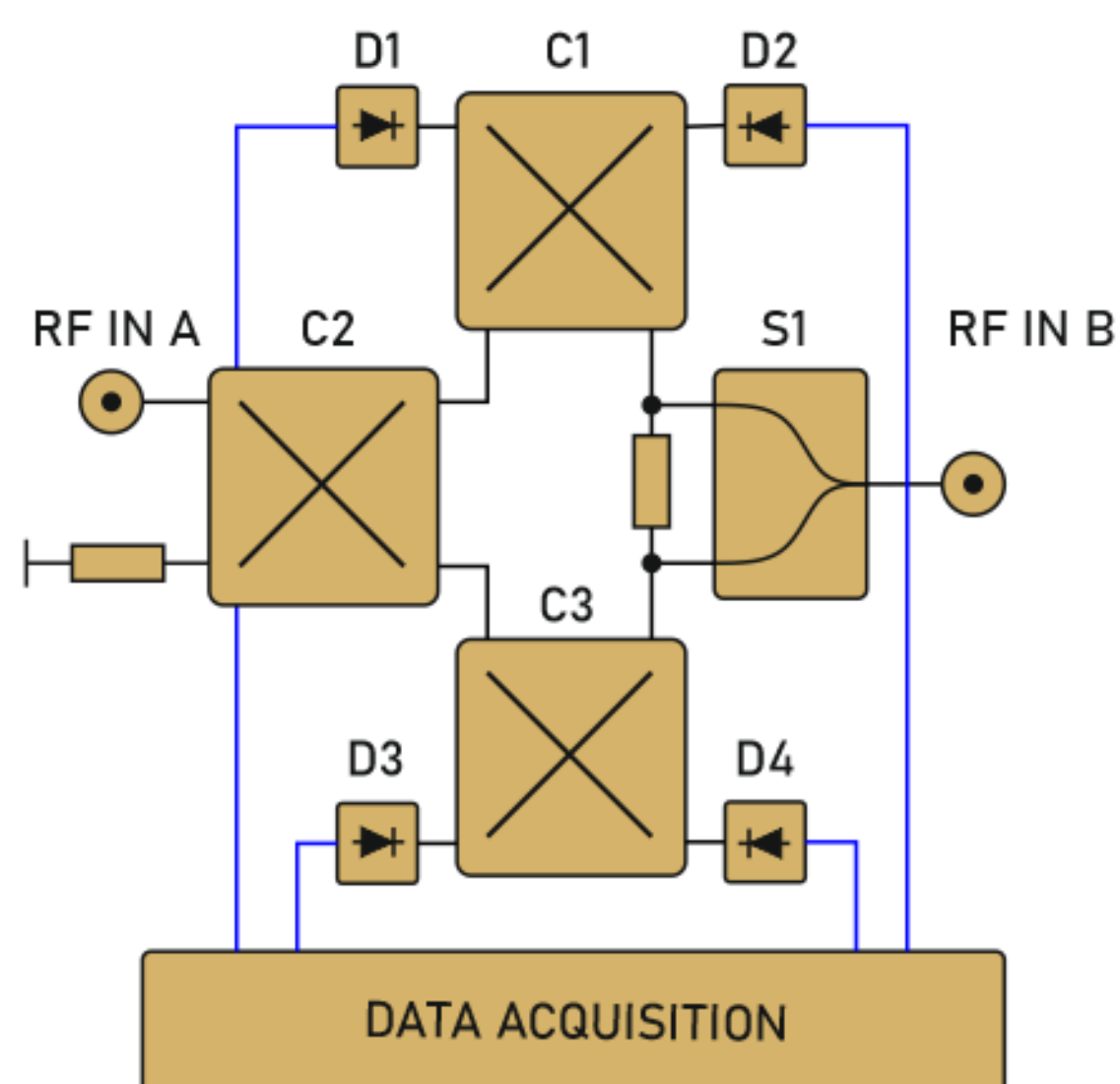
For the SINBAD PRDS link prototype, a custom six-port-based structure has been developed, compared to other analog-based RF phase detector circuits, and the results are presented.

Design motivation

- Improving RF input frequency range of drift detection, which limits the usage of compensation methods in higher frequency PRDS, like for instance in SINBAD,
- Improving RF phase sensitivity – a minimal phase change that can be observed by the detector,
- Reducing temperature drift of the detector's output voltage that will directly affect the phase readout.

Block diagram & module photo

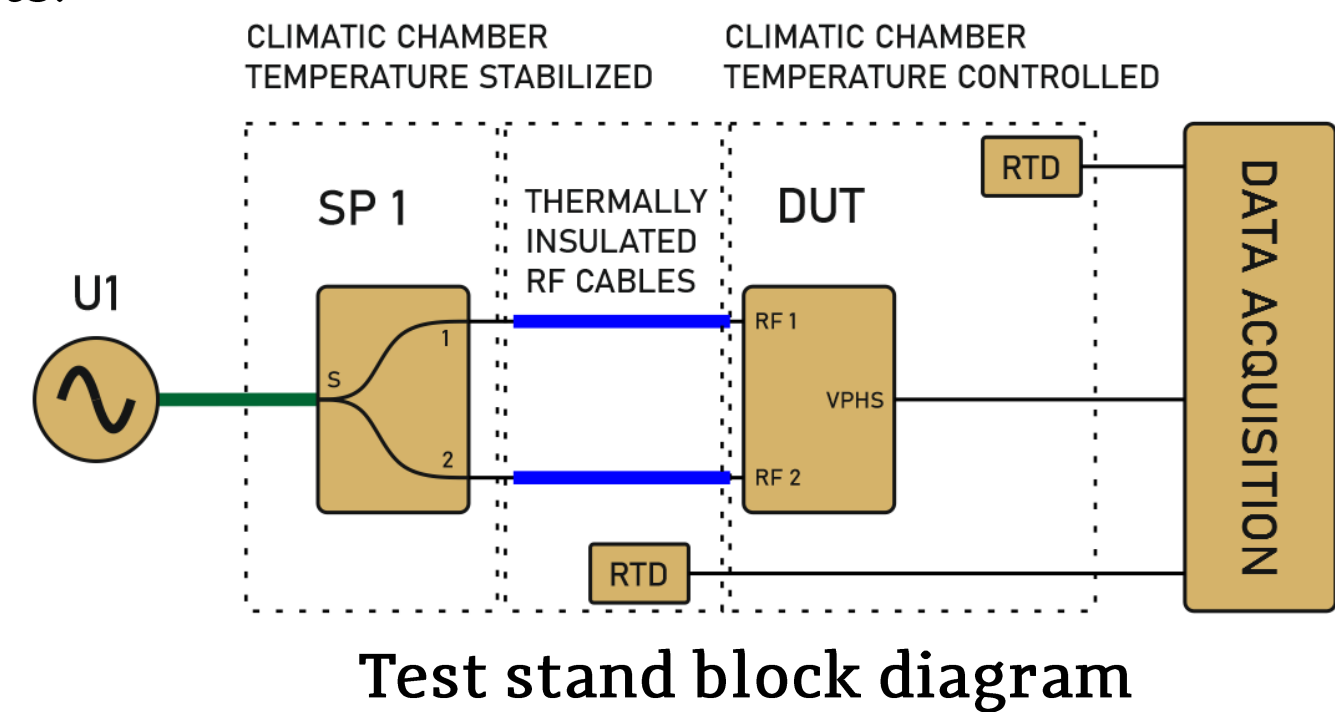
Designed six-port module block diagram



Designed six-port module photo

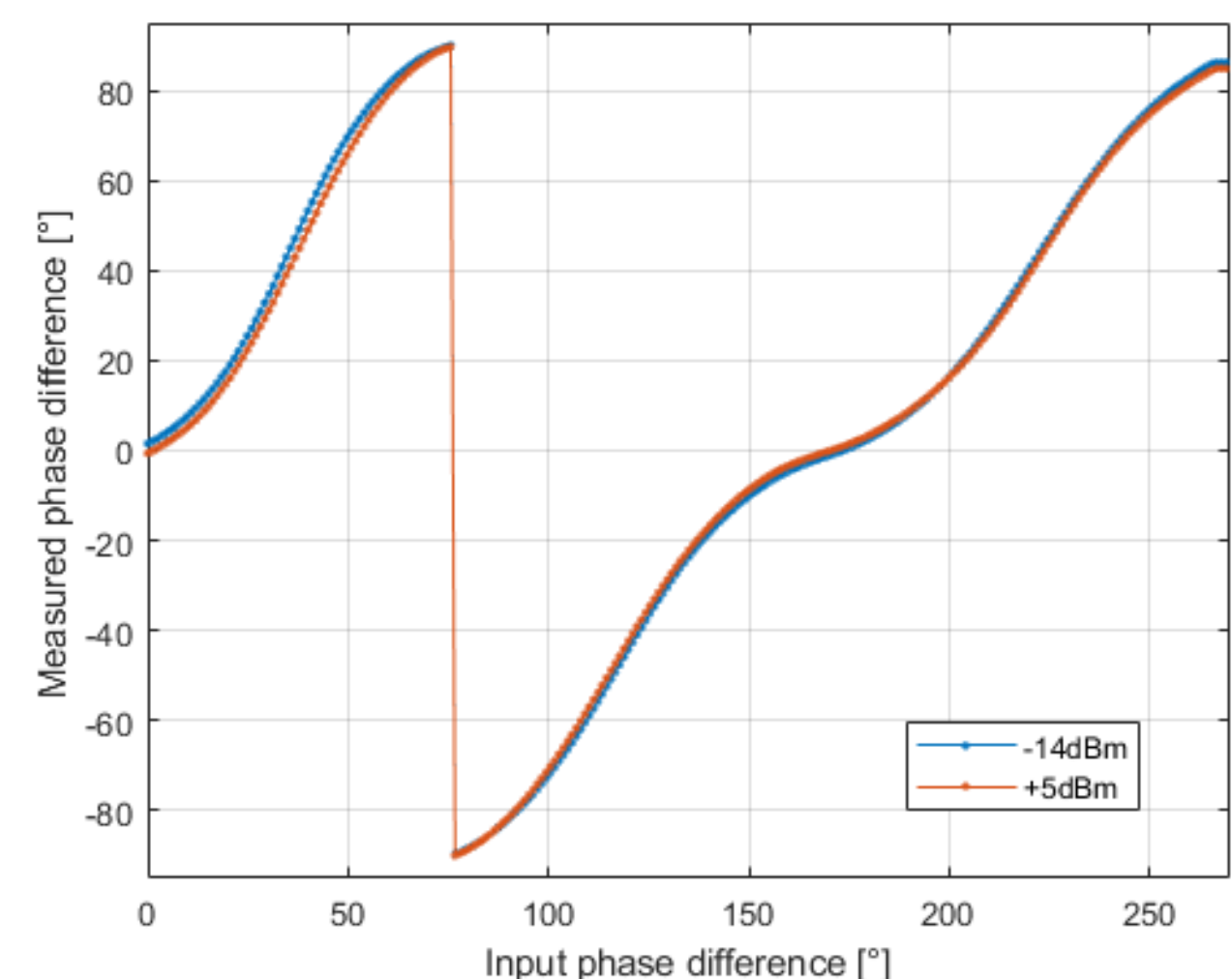
Test results

The six-port structure was tested in a custom-made test stand, designed to alter and monitor the temperature of the detector under test and stabilize temperatures of all other test stand elements.



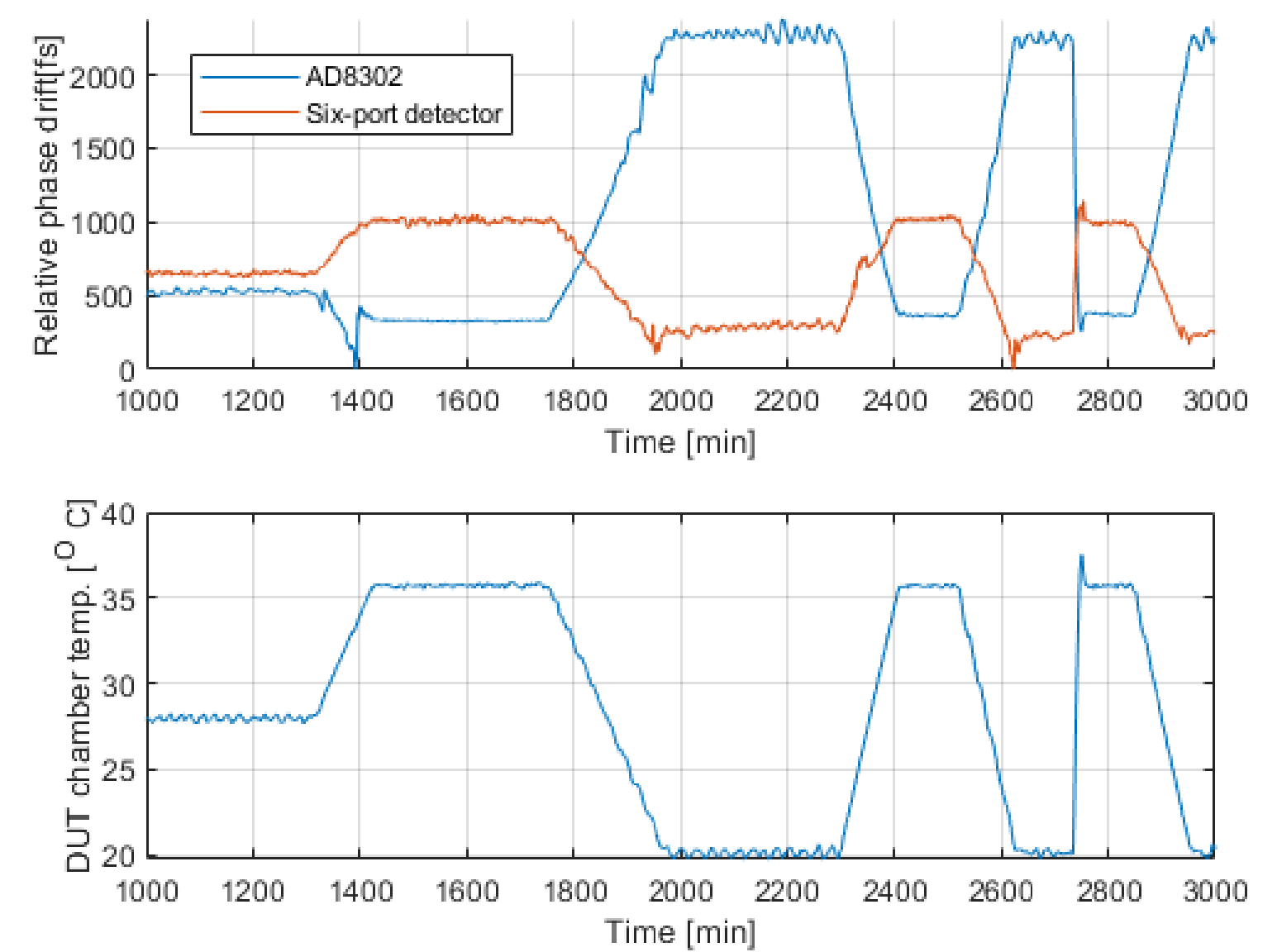
Test stand block diagram

The six-port module input phase difference versus measured phase difference plot for two input power levels is presented in the figure below.



Test stand block diagram

The temperature plot of the detector's chamber and measured detectors' phase drifts are presented below. The designed structure is compared to Analog Devices AD8302 based module.



Long-term phase drift results for compared phase detectors.

References

1. S. Simrock, Z. Geng, Low-Level Radio Frequency Systems, Springer Cham, 2022
2. A. Koelpin et al., "Six-Port Based Interferometry for Precise Radar and Sensing Applications" in Sensors, vol. 16, no. 10, p. 1556, Sep. 2016, DOI: 10.3390/s16101556
3. G. Pietrzykowski, "Opracowanie struktur sześciowrotników pomiarowych na częstotliwość 3.0 GHz dla systemu synchronizacji akceleratora ARES", MSc thesis, Warsaw University of Technology, 2021

Contact

Maciej Urbański, email: maciej.urbanski@pw.edu.pl